

We claim:

1. A method of embedding a digital watermark in a digital image to be printed on an object comprising:

embedding an auxiliary signal in the digital image so that the auxiliary signal is

5 substantially imperceptible, yet machine readable;

converting the image to a halftone image using an inherently unstable halftone screen structure that is likely to cause ink flow errors when reproduced, wherein errors introduced by reproducing the unstable halftone screen structure incorrectly are automatically detectable by reading the auxiliary signal.

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2. The method of claim 1 including spread spectrum modulating a carrier signal with message to form the auxiliary signal.

3. The method of claim 2 wherein the message includes information used to
15 determine the type of halftone screen used to create the halftone image.

4. A computer readable medium on which is stored software for performing the method of claim 1.

20 5. A printed object carrying a halftone image created by the method of claim 1.

6. A method of authenticating a printed object comprising:

receiving a digital image scanned of the printed object;

detecting a digital watermark in the digital image;

25 using a measurement of strength of the digital watermark to detect reproduction errors due to inaccurate reproduction of unstable halftone screen structures in the printed object.

7. The method of claim 6 including:

using the digital watermark to align the digital image geometrically before
computing the measurement of strength.

5 8. The method of claim 6 wherein the measurement of strength is computed by
evaluating message symbol errors in a message signal carried in the digital watermark.

 9. The method of claim 6 wherein the measurement of strength is computed by
computing a ratio of watermark signal strengths of first and second watermark signals
10 embedded in the digital image.

 10. The method of claim 6 wherein the digital watermark carries a payload
indicating a halftone screen type used to print the printed object, and the halftone screen
type is used to analyze the digital image to determine whether the digital image
15 represents an authentic printed object.

 11. A computer readable medium on which is stored software for performing the
method of claim 10.

20 12. A method of authenticating a printed object comprising:
detecting a first digital watermark from a substrate of the printed object;
detecting a second digital watermark from an image scanned from the printed
object; and using the relationship between the first and second digital watermarks to
determine authenticity of the printed object.

25 13. The method of claim 12 wherein the first digital watermark is embedded in
the surface micro-topology of the printed object by varying the surface micro-topology
according to the first digital watermark signal.

14. The method of claim 12 wherein the first digital watermark is embedded in an invisible ink on the printed object.

5 15. The method of claim 12 wherein the first digital watermark is used to geometrically align image data scanned from the printed object, and the second digital watermark is detected from the aligned image data.

16. A computer readable medium on which is stored software for performing the method of claim 12.

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17. A method of authenticating a printed object comprising:
detecting a visible fiducial in an image scanned from the printed object;
detecting a location of a digital watermark hidden in the printed object;
determining authenticity of the printed object by comparing the location of the
15 digital watermark to the visible fiducial.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50.